

Nematodes and Other Introduced Pests that Provided Impetus for the Establishment of Regulatory Agencies in United States¹

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INTRODUCTION: At the turn of this century the US was one of the last major nations to enact federal legislation to exclude exotic pests. Legislation was first introduced in 1898, but Congress did not pass legislation until 14 years later (Rosenberg 1989). In the interval, the eminent nematologist N.A. Cobb and other USDA scientists had rejected a foreign government's gift of cherry trees due to infestation with nematodes and other pests. These actions caused concern in the highest levels of the US government and further focused attention on the need for national quarantine legislation (Jefferson and Fusonie 1977). The objective of this circular is to provide a historical overview demonstrating how root-knot nematodes and other introduced pests and diseases provided public support for quarantine or pest exclusion legislation and the establishment of North American regulatory agencies.



Fig. 1 The Jefferson Memorial at cherry blossom time around the mid-1940s.



Fig. 2. USDA scientists inspecting the first shipment of Japanese cherry trees. January 7, 1910.

EARLY HISTORY OF PLANT AND PEST INTRODUCTIONS IN THE UNITED STATES: Of the food crops grown in the US today, only blueberries (*Vaccinium* spp. mostly cultivars of *V. corymbosum* L.), cranberries (*Vaccinium macrocarpon* Aiton), strawberries (*Fragaria x ananassa* Duchesne), pecans (*Carya illinoensis* Wangenh.), black walnuts (*Juglans nigra* L.), brambles (*Rubus* spp., including blackberries and dewberries), and some grapes (*Vitis* spp., esp. muscadines, *V. rotundifolia* Michaux.) are native (Foster 1991). As Europeans began exploring and colonized North America, they brought familiar food plants from their home countries. On his second voyage, Columbus started the trend to bring new plants to the New World. In the late 1700s American diplomats were ordered to send back to the US rare plant material (Foster 1991). Beginning with the 1800s, plant exploration was supported by the federal government. Undoubtedly, new nematodes were inadvertently introduced with some of these imported new crops. In the late 1800s and early 1900s, US scientists imported soil from China and Japan to ensure adequate inoculum of nitrogen-fixing bacteria for the newly imported legumes (Fairchild 1948). Soil from these fields was then used to inoculate other fields. Recommendations actually were given to farmers as to how much soil they should obtain from previously inoculated fields and distribute with the seed when a legume was planted in a field for the first time (Hopkins 1904). Fortunately, some scientists recognized that this practice was shortsighted. In 1916, a scientist from a Georgia Experiment Station warned that seed and soil inoculations had

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serious drawbacks since "troublesome plant maladies, such as cotton wilt, pea wilt, melon wilt, and nematodes" were being distributed (Temple 1916). It has been speculated that the soybean cyst nematode (*Heterodera glycines* Ichinohe) may have been introduced with soil that was imported to provide nodulating bacteria (Noel 1992). Unfortunately, when new plants and crops were imported, adequate precautions frequently were not taken to prevent the importation of these hitchhiking pests on the newly imported plants and crops.

INFLUENCE OF PEST INTRODUCTIONS IN EUROPE: Today, it is difficult to imagine that one hundred and fifty years ago there was no government agency, anywhere in the world, that specifically focused on regulating plant pests. The role of insects in destroying crops had been recognized for thousands of years, but an understanding of the role of microscopic organisms such as fungi and nematodes as causal agents of plant diseases developed in the mid-1800s. For example, about this time, the devastating *Phytophthora infestans* (Mont.) de Bary, causal agent of the potato blight in Europe, was discovered. This potato disease resulted in the death by famine of one million Irish peasants. The human misery and social upheaval was followed by mass emigration of Europeans to America. A few years later, in 1859, the importance of plant nematodes began to be recognized when Schacht discovered the sugar beet cyst nematode, *Heterodera schachtii* Schmidt, which inflicted heavy losses in many fields in Germany. In this same decade, a series of exotic plant pests and diseases began to afflict the French vineyards, leaving an indelible impression that introduced pests might threaten French culture as much as any invading army. Powdery mildew fungus, *Oidium tuckeri*, Berk., probably introduced from America, reduced French wine production by 80%. Extensive application of sulfur, which controlled powdery mildew fungus allowed the wine production to rise again. To select grape cultivars resistant to powdery mildew, American grape rootstocks were imported, unfortunately accompanied by a hitchhiking root aphid, *Phylloxera vastatrix* (Planch.). This root aphid that had done little damage to grapes in America, became devastating to French rootstocks in the 1860s. In response, the French imported aphid-resistant American grape rootstocks, but this time introduced the downy mildew fungus, *Plasmopara viticola* (Burk. & Curt.) Berl. & de Toni. In the 1870s, downy mildew fungus became the third and most devastating grape plague, the monetary loss amounting to nearly \$50 billion and resulting in European wine production in the 1880s being far less than it was in the 1840s (Schumann 1991).

In response to these events, European governments began enacting unprecedented legislation to exclude or quarantine plant pests that were known to be causing serious economic losses in other countries. In 1873, Germany enacted legislation to prevent establishment of grape phylloxera aphids; and, in 1875, prohibited the importation of Irish potatoes, (*Solanum tuberosum* L.) from the United States to prevent introduction of the Colorado potato beetle, *Leptinotarsa decemlineata* (Say). In the next few years, other European countries enacted similar legislation (Dowling *et al.* 1982).

GROWING CONCERN FOR LEGISLATIVE ACTION IN THE US: Meanwhile, in the US, growers were experiencing the negative impact of introduced pests such as cottony cushion scale (*Icerya purchasi* Maskell) in 1869 from Australia and the San Jose scale (*Quadraspidiotus perniciosus* (Comst.)) from China in 1879. In response, in 1881 California enacted the first plant quarantine legislation in the United States in an attempt to exclude new pests and diseases of grape. In 1885, California passed legislation authorizing the inspection of all incoming plant material (Anonymous 1933; Foster 1991). In 1889, a law was enacted in Florida that stated: "It is unlawful for any person to knowingly sell or give away any diseased nursery stock or seeds in the State of Florida. Any person violating this section shall be fined not more than \$500 or imprisoned not more than six months." Thirty-nine of the 48 states in the USA had enacted quarantine legislation by 1908 (Dowling *et al.* 1982). In 1911, a more comprehensive State Nursery Inspection Law was passed in Florida. By 1915 the citrus canker problem had caused so much concern that the State Plant Board in Florida was established by the State Plant Act (Dowling *et al.* 1982).

The federal government, however, was slower and more reluctant to introduce quarantine legislation. With the introduction of the boll weevil (*Anthonomus grandis* Boheman), the white pine blister rust (*Cronartium ribicola* Fischer), and the chestnut blight fungus (*Endothia parasitica* (Murr.) P.J. & H.W. Anderson), pressure mounted for a unified national effort to exclude such pests (Foster 1991). In 1898, an effort was made to pass a national plant quarantine law, but Congress failed to pass it (Rosenberg 1989). James Wilson, US Secretary of Agriculture from 1897-1913, supported the concern of some USDA scientists that plant introductions also could introduce devastating pests.

Fortunately, by 1906, the USDA began to develop its own inspection process for the plants it imported. This was an important step because Secretary Wilson actively supported plant introductions, since one of his primary goals was agricultural self-sufficiency for the US. To further this objective, he established the Office of Foreign Seed Plant Introduction, headed by David Fairchild, a plant explorer who was responsible for introducing into the US over 75,000 plants (Jefferson and Fusonie 1977). Fairchild's efforts to import ornamental flowering cherry trees (mostly, *Prunus serrulata* Lindl.) would ultimately test the integrity of the USDA inspection process.

THE GIFT THAT FOCUSED GOVERNMENT ATTENTION ON IMPORTED PESTS: One of the key projects of Mrs. William Howard Taft, wife of President Taft, was to beautify the "speedway", the several mile open corridor that stretched from the presidential memorials to the capitol building. David Fairchild convinced Mrs. Taft that Japan's flowering cherry trees should grace this area (Fig. 1). Because of Fairchild's earlier contacts with Japanese officials when he imported 30 cultivars of cherry trees, the word spread in Japan of Mrs. Taft's project to plant Japan's "Royal Flower." Before long, the news arrived through diplomatic channels that the mayor of Tokyo had decided to donate 2000 trees to the project. The newspapers in Washington D.C. added to the local excitement by covering this event, which now involved high government officials. The trees arrived in Seattle on December 10, 1909 and were sent by train to Washington, D.C. When they arrived in early January, the USDA inspection team, which included the eminent nematologist N.A. Cobb, was sent to examine the flowering cherry trees (Fig.2). They observed several species of scale insects, wood-boring lepidopteran larvae, and root-knot nematodes on the trees. In his report to Secretary of Agriculture Wilson, the head of the inspection team, C.L. Marlett, stated that this shipment of trees had the worst infestation of scale insects and root galls he had ever encountered, and courageously recommended that the trees be "destroyed by burning" (Fig. 3). He also stated that Cobb had found that about 72% of the lots were infected with root-knot nematodes. Cobb reported that in all probability the vast majority of the trees were infested with root gall nematode and the soil contained large numbers of various species of nematodes, including a number of injurious species. He is quoted as concluding: "I have no hesitation in saying that in a country where a proper inspection of disease material was legally in force with the object of protecting agriculture, the importation of these trees would not be permitted" (Jefferson and Fusonie 1977). This biological risk assessment by a USDA scientist was not a politically comfortable position. These recommendations resulted in a series of consultations among highest levels of government including the Secretary of State, Secretary of War, and the President, who was likely well informed since this was his wife's project. In the end, the mayor of Tokyo was diplomatically informed that because of the experiences with destructive foreign pests, the USDA had no choice, "but the painful duty of destroying the trees". The following year, the Japanese government involved their best scientists in preparing a new pest-free gift of 6000 trees that had been fumigated twice with hydrocyanic acid gas to assure that the embarrassing incident would not be repeated (Jefferson and Fusonie 1977).

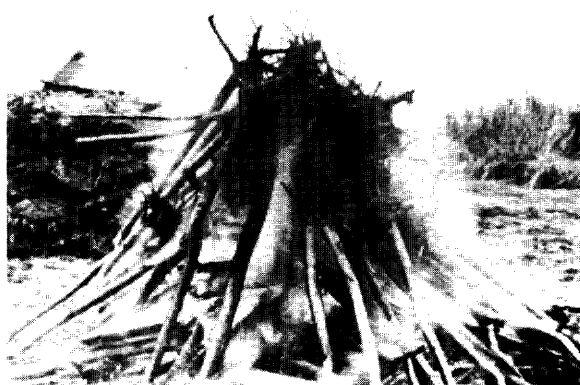


Fig. 3. Part of the first shipment of Japanese cherry trees being burned.



Fig. 4. Cherry trees, as they appear in 1976, planted in 1912 by Mrs. William Taft (left foreground) and by the Japanese ambassador's wife, Viscountess Chinda (right foreground).

After this second shipment arrived, the first trees were planted by Mrs. Taft and the wife of the Japanese Ambassador (Fig. 4). In 1923, the mayor of Tokyo and his daughters visited Washington D.C., and enjoyed the flowering cherry trees, indicating the success of both science and diplomacy 13 years earlier (Figs. 5, 6). But in retrospect, the US also may have benefited greatly from the mayor's first gift. It may have been the root-knot nematodes and other pests that accompanied the mayor's first gift that finally helped to convince the US Congress to pass the Plant Quarantine Act of 1912, which is considered the watershed for all subsequent federal quarantine legislation.



Fig. 5. Mayor and Mrs. Yukio Ozaki of Tokyo, Japan, (circa 1910) around the time of the destruction of the first shipment of Japanese cherry trees.



Fig. 6. Mayor Ozaki and daughters among the cherry trees Potomac Park, 1923.

Acknowledgment: Photos (Figs. 1-6) are from Jefferson and Fusonie (1977), courtesy of the National Arboretum.

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